April 14, 1961

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Contracting Officer's Technical Representative
Task Order #2

STATINTL   Subject: Comprehensive Photogrammetric Computing System
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Dear

     Enclosed are the three documents resulting from our
discussions of March 18 and April 11, 1961. They are:

     Item 1, a statement describing methods of handling the
     increased problem load of the Comprehensive Photogrammetric
     Computing System;

     Item 2, a statement describing the programming of the
     Control Extension problem for the Comprehensive Photo-
     grammetric Computing System; and

     Item 3, a statement describing the financial status, cost
     forecast, and task schedule for the Comprehensive Photo-
     grammetric Computing System.

     If you have any questions, please contact me directly.   STATINTL

Sincerely yours,

Declass Review by NIMA/DOD

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Item 1

Methods of Handling Increased Problem Load

for the

Comprehensive Photogrammetric Computing System

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As additional programs for the [ ] III-E computer are com-   STAT
pleted by [ ] the operational use of these programs will result
in an increased problem load on the present computer. Due to this
increased volume of problems and, also, to the additional computer
time required for testing the many programs which are being pre-
pared, a single [ ] III-E computer will be inadequate.

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STATINTL   Table I lists all of the photogrammetric problems being pro-
grammed by [ ] the running times for each of these problems for
a single run; the expected number of runs per month for a number
of these problems; and the total machine hours per month for these
same problems. The sum of the hours in the last column represents
the total monthly running time for the listed problems. It can
readily be seen that this figure, 325.2 hours (minimum), far exceeds
the 173 hours per month normally available in single shift operation.
When the presently existing load is added to the above figure for
the listed problems, the operational load will become even larger.

In addition to the normal monthly operational load, programs
now being written must be tested. Table II lists the estimated
computer time required for testing each program.

In order better to appreciate the impact of the problem load
on the present computer installation, a graph has been included
which presents a picture of computer operating time on a month-by-
month basis. The graph includes (1) the estimated present monthly
operational load, (2) the estimated increase in problem load as
programs now being prepared (Table I) are completed, and (3) the

program testing load (Table II) broken down into monthly require-

ments. It is apparent that by the end of August, 1961 the normal

STATINTL single shift capacity of the [   ] III-E computer will have been

exceeded.

Since the present computer installation will be inadequate to

handle the anticipated problem and testing load, the following

recommendations are made: STATINTL

STATINTL   (1) As an interim measure, a second [   ] III-E computer, STATINTL

to be housed at the Washington office of [   ]

[   ] should be obtained immediately; and

(2) as a long term measure, the [   ] III-E computers should STATINTL

be replaced with a much higher speed, though not necessarily

a larger capacity, computer as soon as possible.

STATINTL   The need for a second [   ] computer is obvious due to the

increasing program load. However, it should be emphasized that

STATINTL the use of the two [   ] computers would only be temporary and

that as soon as a high speed computer can be obtained (normal 12
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STATINTL to 18 month delivery) the [   ] computers would be retired. The
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advantages of housing the second [   ] computer at [   ] center mainly

on more rapid program preparation and on a favorable cost basis if

obtained before May 31, 1961 as is explained more fully in the

Appendix. The reasons for obtaining a high speed computer (to

replace the [   ] as soon as possible are:

STATINTL   (1) An ever increasing problem load, eventually surpassing

STATINTL   the capacity of two [   ]

(2) the demand for immediate answers to long problems;

(3) the likelihood of a greater frequency of problems of

increasing complexity, such as the control extension (see

Item 2), which are beyond the computing speed capability of

STATINTL the ☐ III-E computer; and

(4) the desirability of eventually carrying out all com-
putations at one location.

Among the many factors which may influence the choice of a
new computer, the factors of speed and capacity will be discussed
here. These two factors are based solely on the photogrammetric
tasks, that is, on the present problem load, the estimated problem
load as photogrammetric tasks being programmed are completed, and
the assumption that the work load will continue to increase in
STATINTL size and complexity. It is recommended, then, that the new com-
puter should have a speed roughly <u>10 to 30 times as fast</u> as the
present ☐ III-E, that is, that the combined access and add
times should range between 0.1 and 1.0 msec. A capacity of 4000
to 8000 words would be sufficient. A number of computers come close
to fulfilling these requirements. Among them are the

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✓) BOTH AMONG FINAL THREE
✓✓) COMPUTERS RECOMMENDED BY
       DY- JUNE '59
✓✓ ☐   FINAL RECOM.
       Page 83, 84. STATINTL

Recommendation of a specific computer would require more precise
information concerning problem characteristics, volumes, and your
requirements for data handling. Further consideration of the
variables related to machine selection would require more effort
on our part than we wish to provide without specific direction to
that effect.

As soon as a new computer has been chosen, programming of all
the photogrammetric tasks for that machine should be initiated so
that programs would be available by the time the new computer is
delivered.

Item 1, Appendix

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Acquisition of a Second ☐ III-E Computer   STATINTL

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STATINTL   The addition of a second ☐ III-E computer, to be housed

at ☐ would have the following advantages:

(1)   A machine would be provided to handle the overflow from
peak loads on the present machine;

STATINTL   (2)   the ☐ machine would be available for second (or even
third) shift operation as the operational load increases;

(3)   a standby machine would be available when the present
machine is down;   STATINTL

(4)   all program testing would be carried out on the ☐
machine, leaving the present machine free for its scheduled
work load;

(5)   chargeable programming time, lost in traveling to and
from the present machine installation, would be eliminated;

(6)   relatively low-cost clerical personnel would be utilized
for typing and proof reading programs;

(7)   with a machine continuously available at ☐ programming,   STATINTL
and thus delivery of completed programs, would be considerably
speeded;

(8)   the cost of leasing the second machine would be consider-
ably offset by the reduced cost, due to reduced time loss,
in programming and by the other benefits already mentioned; and

(9)   the second machine can be provided by ☐ on a favorable   STATINTL
cost basis if it is obtained before May 31, 1961.

The second computer will be available to ☐ on a half-time basis
(4 hours per day) at the stipulated rental fee, the remaining   STATINTL
time being reserved for the ☐

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fails to use its four hours in any one day, the unused time would
be available to ☐ free-of-charge. The ~~times~~ for obtaining ~~the~~STATINTL
changes
second ☐ are -

Moving and Installation

Rental, Half Time, per month

Overtime rate, per hour

Item 1, Table I

STATINTL [ ] III-E Operational Load

Tasks	Machine Hours/Run	Number of* Runs/Month	Total Hours /yw.
Camera Calibration	0.25	15	3.75
Attitude from Horizon Exposures, full fan	0.4	350	140
Terrestrial Photography, 1-3 photos, 3 iterations	0.2-4.5	20	4.0-90
Shadow Factor, mission	0.25	350	87.5
STATINTL Height Determination, per photo, n points	$0.03 + 0.02n$	50 pts. 15 photos	15.45
[ ] Rectifier, 2 parts	0.1, 0.1		
Rectifier	0.5-1.5		
Photo Coordinate Corrections	0.1-0.3	445	44.5-133.
Coordinate Rotations	0.1-0.3		
Geographic to UTM or Inverse	0.1	50 pts. 5 photos	25.0
Geographic to Oblique or Inverse	0.1		
Control Extension, 2-3 photos	0.5-1.0	10	5.0-10.0

Total   325.2-505

* These figures have been supplied by the Contracting Officers Technical Representative and assume sufficient manpower available to prepare program inputs.

Item 1, Table II

Program Testing Load

Tasks	Total Machine Hours for Testing
Camera Calibration	15.0
Attitude from Horizon Exposures	20.0
Terrestrial Photography	35.0
Shadow Factor	10.0
Height Determination	6.0
Rectifier	5.0
Rectifier	15.0
Photo Coordinate Corrections	3.0
Coordinate Rotations	16.0
Geographic to UTM and Inverse	22.0
Geographic to Oblique and Inverse	22.0
Control Extension, 2-3 photos	75.0
Total	244.0

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Item 1, Graph
Projected Minimum Machine Load
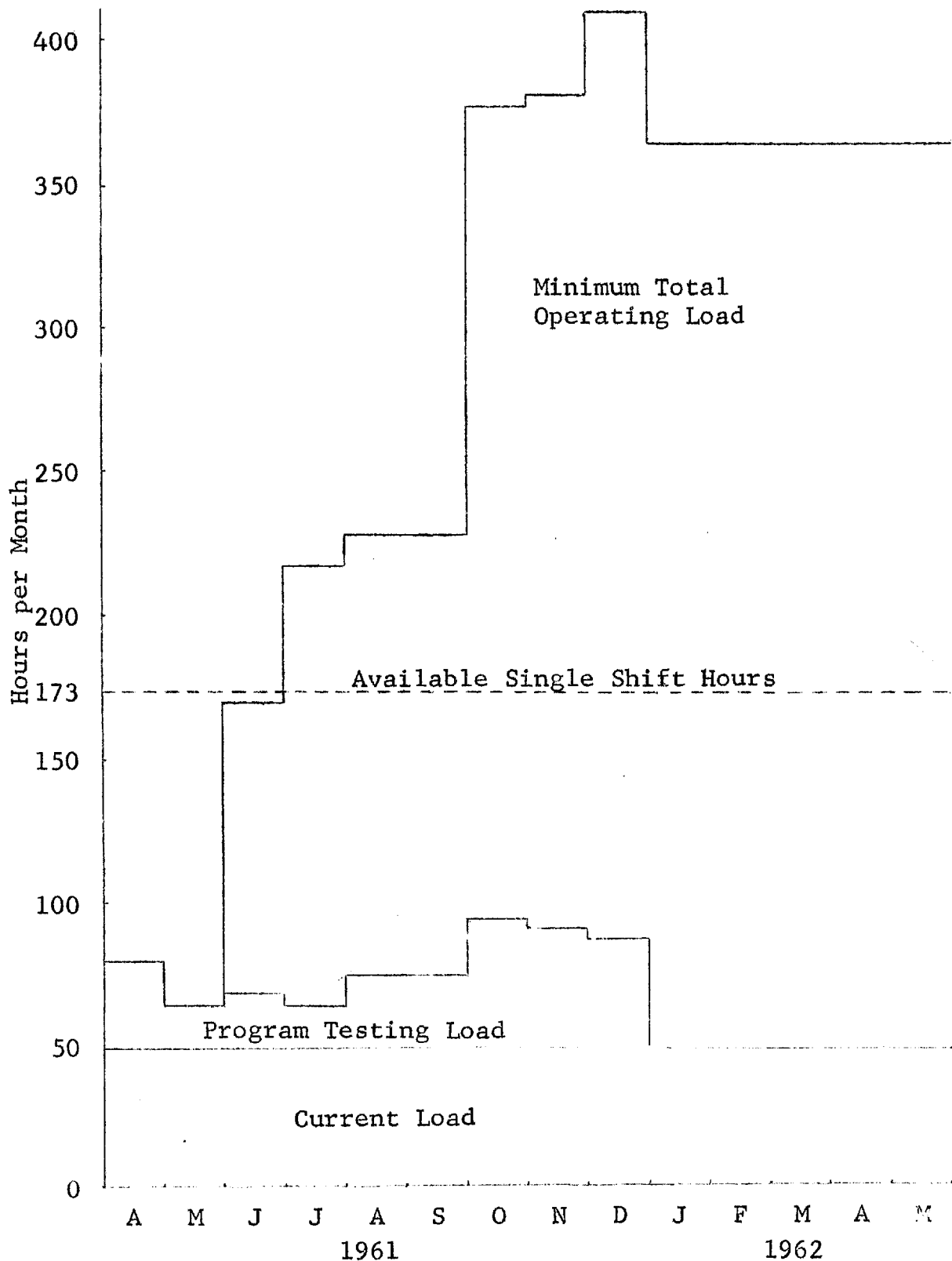
Item 2

Programming of the Control Extension Problem
for the
Comprehensive Photogrammetric Computing System

Two of the tasks outlined in the work statement for the Comprehensive Photogrammetric Computing System involve the problem of control extension. A major computational task in this problem is the inversion of a large matrix. The size of this matrix is a function of the number of unknown parameters to be determined for each photograph and the total number of photographs. Since there are, normally, six such unknowns for each photograph, a control extension of ten photographs (as requested in the work statement) would require the inversion of a 60 x 60 matrix. An investigation

STATINTL of the capability of the ⬚ III-E for handling the inversion of matrices of this size has lead to some adverse conclusions concerning the practicability of carrying out the control extension of ten photos on that computer. For example, to complete one iteration (matrix inversion) of a ten photo control extension would require 50 hours of machine operation. Since an average of three iterations are required to reach convergence, nearly 150 hours of machine time would be needed. Normally, one would

STATINTL not expect the ⬚ III-E to operate continuously for even 24 hours, let alone for over six days, without a breakdown. On the

STATINTL other hand, a high speed computer, such as one of those suggested by ⬚ (Item 1), could complete a 10 photo control extension in less than 10 hours with no expectation of a breakdown.

In view of the exceedingly long running time required for

STATINTL the control extension on the ⬚ III-E computer and the expected unreliability over such a period, the following recommendations

are made for handling the special case of the control extension
(and any other problems of such a complex nature which might
occur):

(1) A limited (2 or 3 photo resection and intersection)
extension should be programmed for the [   ] III-E computer STATINTL
and

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(2) upon choosing a high speed computer to replace the
present [   ] III-E the full 10 photo control extension
should be programmed utilizing a compiler (e.g., FORTRAN
or ALGOL) compatible with the chosen computer. Until de-
livery of the new computer, the control extension program
could be run on any computer capable of handling the chosen
compiler.